Determinants of Physicians' Decisions to Specialize*

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Abstract

In this paper, we study physician specialty decisions using several unique data sets which include information on almost all Canadian physicians who practised in Canada between 1989 and 1998. Unlike previous studies, we use a truly exogenous measure of potential income across general and specialty medicine to estimate the effect of income on physicians' specialty choices. Furthermore, our estimation procedure allows us to purge the income-effect estimates of non-pecuniary specialty attributes which may be correlated with higher paying specialties. Understanding the effect of potential income (and other variables) on choices is necessary if the desired mix across generalists and specialists as well as across specialties is to be achieved. Our results show that physicians respond to differences in income when making their specialty decisions. More specifically, our simulation exercise suggests that provinces could increase the proportion of graduates who select a surgical specialty by increasing the fees they pay to them.

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1 Introduction

Although health care constitutes an ever increasing share of public expenditures, in many countries, including Canada, complaints of longer waiting times and reductions in services are rampant. Many believe that the rationing of services is the result of physician shortages both in general care and in certain specialties. As a result, understanding how individual characteristics, institutional factors and, potential income differences across specialties, impact physicians' decisions to specialize and, conditionally, their choices among specialties, is important if we are to achieve the desired mix of physicians across general and specialty medicine as well as across different specialties. In particular, understanding whether or not, and to what extent, physicians respond to potential income differences when making their specialty decisions is important if we are to consider 'income' as a policy tool. Unlike previous studies, we use a truly exogenous measure of potential income across general and specialty medicine to estimate the effect of income on physicians' specialty choices. Furthermore, our estimation procedure allows us to purge the income-effect estimates of non-pecuniary specialty attributes (such as status or research opportunities) which may be correlated with higher paying specialties.

Several studies have examined the determinants of physician specialty choices. A number of these find that physicians react to differences in income when making their specialty decision (Sloan (1970), Hadley (1975, 1977, 1979), Hay (1980, 1981), Hurley (1991)). However, their elasticity estimates are likely to be biased given that they use average income across specialties which may not (fully) account for unobserved differences across physician pools such as productivity, skills, effort or hours worked. In a recent paper, Nicholson (2002) estimates a model of physicians' decisions to specialize using data from the 1992 National Resident Matching Program. He argues that capacity constraints in different residency programmes may yield inconsistent income elasticities. That is, although physicians may wish to react to differences in expected income when choosing their specialty, their ability to do so may be limited by the availability of spaces in certain residency

programmes. By using a data set which includes information on the physician's desired specialty (which may not be the physician's ultimate specialty), Nicholson finds that medical students are very responsive to expected income differences between specialties. Several limitations should, however, be noted. First, as in previous studies, expected income (conditional on a given specialty) is estimated without taking into account potential sample selection problems. Furthermore, elasticity estimates rely on the assumption that individual ability is uncorrelated with unobserved preferences for unmeasured non-pecuniary specialty attributes.

In this study, we examine the determinants of specialty choices (both the decision to specialize and the choice among specialties) by addressing several of the limitations noted above. By using a unique data set which includes information on almost all Canadian physicians who practiced in Canada from 1989 to 1998, we attempt to identify the effect of different characteristics (both personal and institutional) on physicians' decisions to specialize and choices among specialities. Furthermore, the Canadian system, whereby physicians are paid on a fee-for-service basis, allows for a unique opportunity to estimate the effect of potential income differences across specialties on physicians' choices without having to deal with selection issues. Since payments to physicians are based solely on the task performed and the physician's specialty, and *not* on any other observed or unobserved individual characteristics, using such payments as proxies for potential income avoids the possible aforementioned bias when estimating income effects. As a result, we are able to identify the effect of income on the decision to specialize and the choice among specialties by exploiting the variation in exogenous 'fees' across time, across provinces and across general and specialty care. Furthermore, because we identify the income effect through variations in these exogenous fees, we avoid the potential bias which could be introduced if preferences for unmeasured specialty attributes are correlated with income. For example, if certain specialties exhibit both higher expected income and other unmeasured non-pecuniary benefits (such as prestige or a better research environment), then the income effect estimates may be biased. However, because these non-pecuniary attributes are unlikely to change greatly over-time or across provinces, while the exogenous fees paid to

physicians do, using variations in income instead of differences in levels, allows us to avoid this problem. Furthermore, we develop a two-stage model which allows us to control for both observable and unobservable characteristics which are specific to the physician's market including rationing in residency programmes.

The remainder of the paper is organized as follows. In section 2, data and summary statistics are presented. The theoretical model is presented in section 3. In section 4, we develop the empirical specification and estimation strategy. Results are presented in section 5. Finally, conclusions are drawn in section 6.

2 Data and summary statistics

The data set used in this paper is constructed from three main sources.[1] The first, the Southam Medical Data Base, contains information on almost all Canadian Physicians who practiced in Canada at any time between 1989 to 1998.[2] This data set contains information on the physician's age, sex, year of graduation from medical school, the country of graduation, the medical school attended if the physician graduated from a Canadian University (and consequently the province of residence at the time of graduation), the practice specialty and, the physician's self-identified language. The second set of data (discussed in greater detail below) includes yearly, province-specific information on the 'average cost-per-consultation' (a measure of the fees paid to physicians per visit) for both general and specialty care. It also includes yearly, province specific information on hospitals, physicians, drugs and capital expenditures. These variables are used later as proxies for the 'state' of the health care market in each province at the time of the physician's specialty decision; variables which may influence a physician's decision to specialize and, his or her choice between surgical and non-surgical specialties. The third data set, from OECD health data files

[1] See Section 7 (Data Appendix) for a detailed description of the data.

[2] The initial data set contains information on all Canadian physicians who practiced in Canada at anytime between 1989 and 1998. Excluded from our study are physicians with incomplete files and those who requested that their date of birth be removed from the data file (via a formal request). We also exclude all physicians whose year of graduation was either (i) before 1975 or (ii) after 1991, because of estimation considerations discussed later on.

(2000), includes information on the Canadian population and Canadian practising physicians.

The model, presented below, is estimated using a sample of 30,184 physicians who practiced in Canada between 1989 and 1998 and whose year of graduation from medical school is between 1975 and 1991.[3] As we are studying the decision to specialize and the choice among specialties by physicians at the time of graduation from medical school, we focus exclusively on physicians who graduated from Canadian Universities.[4] Descriptive statistics on physicians, including the number (and share) of females and males, and, the number (and share) of Francophones and Anglophones per graduating cohort are presented in Table 1. In our sample of physicians, 76.3 per cent identify English, rather than French, as their spoken language and 63.4 per cent of the population studied are male. However, as expected, the percentage of males per graduating cohort falls substantially over time. For example, women constitute 44.9 per cent of the graduating class in 1993 but only 22.9 per cent in 1975. In Table 2, we present the number (and share) of physicians who specialized, and conditionally, the number (and share) of specialists in surgical and non-surgical fields (per graduating cohort). It is also important to note that, in our sample, 49 per cent of physicians are coded as Specialists. Furthermore, among Specialists, 26.1 per cent are coded as surgical specialists.[5]

Summary statistics suggest that many defining characteristics of the physician pool -including the number (and share) of females, the number (and share) of physicians who chose to specialize, and the number (and share) of specialists who chose a non-surgical rather than a surgical specialty

[3] Although the original data set is a panel with information for each physician on each year between 1989 and 1998, one single year of information is contained in the data set used for estimation. The year of information is irrelevant given that we use variables which are time invariant (for example: the age of the physician at graduation, the specialty practiced and the medical school he or she graduated from).

[4] These numbers do not reflect all physicians who graduated from Canadian Universities between 1975 and 1991, nor can we be sure that they represent a random sample of such physicians given that a Canadian physician may have emigrated and that the probability of emigrating is unlikely to be independent of physician characteristics (such as specialty type).

[5] Physicians are coded as surgical specialists if they identified their specialty as: general surgery, cardiovascular and thoracic surgery, neurosurgery, obstetrics and gynecology, ophthamology, otolaryngology, orthopedic surgery, plastic surgery, or urology. Physicians are coded as non-surgical specialists if they identified their specialty as: internal medicine and sub-specialties, dermatology, neurology, pediatrics, physical medical and rehabilitation, psychiatry, public health, emergency medicine, anesthesia, nuclear medicine, medical microbiology, pathology, radiology, occupational medicine, medical biochemistry, medical scientist or medical genetics

- have changed over time. The model, presented below, will attempt to identify the determinants of these changes.

We use both provincial and national level variables which may influence physicians' decisions to specialize and choices of specialty. Although the most natural exogenous measure for physicians' potential incomes would be to use provincial fee-for-service schedules across time for both generalists and specialists, what constitutes a consultation (i.e., what is covered by a particular fee) lacks consistency across provinces and has changed considerably over time. As a result, we use the average-cost-per consultation for generalists and specialists which explicitly deals with these inconsistencies.[6] That is, they are based on well defined consultations which are consistent across time and across provinces. The average-cost-per-consultation, is simply the total expenditures paid to Generalists (GPs) or Specialists for well defined consultations divided by the number of such consultations. It is important to emphasize here that using an average-cost-per consultation, instead of average within-specialty income, avoids potential selection biases which have lead to much debate on the validity of prior results. That is, average incomes in certain specialties may be higher than in others, not because they offer higher incomes per say, but rather, because they attract individuals who have unobserved differences such as productivity or work effort (Bhattacharya, 1998). Given that physicians are in fact paid on a fee-for-service basis, the Canadian system allows for the estimation of the effect of income on specialty choice without having to explicitly control for selection issues.

Table 3 reports summary statistics for the average cost-per-consultation for GPs in each province across time (in 1995 dollars). Similarly, Table 4 reports summary statistics for the average cost-per-consultation for Specialists in each province across time. These figures show considerable variation in the cost-per-consultation within and across provinces.[7] Variation within and across provinces of these variables, as well as variation in provincial expenditures on physicians, hospitals, capital,

[6] These data were constructed using the National Physician Database in order to deal explicitly with the consistency issues discussed above. We thank the Canadian Institue for Health Information (CIHI) for providing these data.

[7] We thank CIHI for providing these data.

and drugs, will be used to identify the effect of both pecuniary and non-pecuniary benefits related to specialization. We include the latter set of variables since a physician who observes that his or her province has increased such expenditures (hospital, capital, drug, and/or physician), may view it as an increased investment in the health care system and thus may make specializing more (or less) attractive.

3 Theoretical model

In this section, we present a theoretical model which forms the basis of our estimation strategy. A utility maximizing physician must make a decision on whether or not to specialize and conditionally, which specialty to choose. Both decisions are made simultaneously at the time of graduation (that is, at the time of graduation, the physician either begins to practice or decides to undertake further studies). We subdivide the 'specialty type' into two broad types - surgical and non-surgical. We do this to reflect the within specialty-type similarities in training and requirements and because of limitations in the data.

More formally, at the time of graduation from undergraduate medical training ($t = 1$), physician i in province j must choose his or her specialty type s (no specialty $s = 0$, non-surgical $s = 1$, and surgical $s = 2$), hours worked h and consumption C (for $t = 1, ..., T$) in order to maximize his or her expected discounted life-time utility:

$$\max_{s_i, h_{it}} \sum_{t=1}^{T} \beta^{t-1} U(l_{it}, C_{it}, B^s_{jt}), \tag{1}$$

where l denotes leisure and where B denotes non-pecuniary benefits associated with specialty s (including status and research opportunities). The budget constraint at time t is given by:

$$C_{it} = h_{it} w^s_{jt} - K^s_{it}, \tag{2}$$

where w denotes the wage rate which is specialty s and province j specific and where K^s denotes the

fixed costs associated with subsequent training if the physician has decided to become a specialist (i.e., if $s = 1$ or 2).

Leisure, is defined by:

$$l_{it} = 1 - h_{it}, \tag{3}$$

where total time available is normalized to 1. The wage rate (or fee-per-consultation) is given by:

$$w_{jt}^{s} = w(P_j, s, t), \tag{4}$$

which is province j, time (year) and specialty s specific. Notice that the wage rate (a fee per hour worked or per consultation) is independent of the physician's personal characteristics (i.e., is exogenous to potentially unobserved characteristics) and reflects the fee-for-service setting in Canada.

It is important to consider that a physician who decides to specialize must incur a fixed cost which includes forgone income as well as training costs. As a result, K is defined as:

$$K_{it}^{s} = \begin{bmatrix} \widehat{K}_{it} & if & s = 1 \text{ and } t = 1, ..., \overline{t}^{1} \\ \widetilde{K}_{it} & if & s = 2 \text{ and } t = 1, ..., \overline{t}^{2} \\ 0 & if & s = 0 \end{bmatrix}, \tag{5}$$

where the fixed cost is dependent on the type of specialty (if any) and the amount of years in training ($\overline{t}^{s}$).

In order to solve the model, the physician will compare the lifetime utility across the three different scenarios and choose the specialty which yields the largest lifetime utility at optimally chosen hours of work and consumption. That is, physician i will choose specialty s^* such that

$$V^{s*} = \arg\max_{s} V^{s}(w_{jt}^{s}, K_{it}^{s} | X_{it}, j), \tag{6}$$

where V^{s} is the indirect utility function associated with specialty choice s. We take the decision to specialize and the choice among specialties as a once-and-for-all decision to reflect the fact that

transiting from general care to specialty care during the course of a physician's career is a rare occurrence and to simplify the model.

Several comparative statistics are worth mentioning. First, if potential earnings increase under a particular practice type (relative to the other 2 practice types), the probability that the physician will choose that specialty increases. Thus, we should see the likelihood of specializing increase as specialty average-cost-per-consultation increases. Similarly, if the fixed cost associated with a particular specialty increases, the probability that the physician will choose that specialty will decrease. Thus, we expect that women (because of child bearing and rearing costs) and older physicians (because of shorter careers) should be less likely to specialize.

4 Empirical Model

In this section, we present an econometric model which is consistent with the theoretical model presented above. We define the utility for physician i who chooses specialty choice s as:

$$U_{it}^{s} = X_{it}\beta_{j}^{s} + W_{jt}^{s}\gamma_{t}^{s} + \theta_{j}^{s} + \alpha_{jt}^{s} + \varepsilon_{it}^{s} \tag{7}$$

where the province is denoted by $j = 1, .., J$, the year of graduation is denoted by $t = 1, ..., T$ and, the individual is denoted by $i = 1, ..., n_j$; X_{it} denotes a vector of observable individual characteristics including the physician's age at graduation, sex, medical school attended and language spoken; W_{jt}^{s} denotes all observable characteristics which are province and specialty-type specific including the wage rate as well as provincial expenditures on drugs, capital, hospitals and physicians.[8] We divide the unobserved component of the utility function into three different terms: (i) θ_{j}^{s} which represents a non-pecuniary unobserved province-specialty specific component (such as status), (ii) α_{jt}^{s} which represents unobserved province-time specific effects, and (iii) ε_{it}^{s} which represents an iid error term.

[8] Although wages in competing markets (i.e. different provinces and abroad) may influence a physician's decision to specialize and choice of specialty, our estimates are based solely on the effect of changes in fees in the province in which the physician graduated. In a new paper, we are examining how physicians in one jurisdiction may be influenced by fees in other jurisdictions in both their decision to specialize and their choice to immigrate.

Thus, the probability that physician i in province j will choose specialty s is given by:

$$\Pr(U_{it}^{s} > U_{it}^{k}) \text{ for all other } k \neq s \tag{8}$$

Although we do not observe the utility associated with each alternative for each physician across time, we do observe the physician's choice. From this, we could estimate the model using a Multinomial Logit approach for all individuals of the same province (i.e., we could estimate the model J times).

Given that the model can be estimated separately for each province, we could rewrite (7) to include a time-dummy variable in order to deal with the component which is common to all individual physicians of specialty s of the same province (α_{jt}^{s}). That is, we could rewrite (7) as:

$$U_{it}^{s} = X_{it}\beta_{j}^{s} + W_{jt}^{s}\gamma_{t}^{s} + A_{jt}^{s}\Upsilon(t) + \theta_{j}^{s} + \varepsilon_{it}^{s}. \tag{9}$$

where A_{jt}^{s} represents the province-time specific effect for specialty s. However, by including such an effect, (9) would no longer be estimable (identified) since it also includes observable variables which are province-time specific for specialty s (W_{jt}^{s}).

Because of this, we develop a two-stage approach for estimating the model where we first specify the utility associated with specialty s at time t in province j for individual i as:

$$U_{it}^{s} = X_{it}^{s}\beta_{j}^{s} + \widetilde{A}_{jt}^{s}\Upsilon(t) + \theta_{j}^{s} + \epsilon_{it}^{s}. \tag{10}$$

Note that in (10) we omit all observable province-time-specific variables (i.e., we omit the W_{jt}^{s} vector) and include instead a set of year dummies $\Upsilon(t)$ (one for each specialty in each year), i.e., the year dummies subsume all variables (both observable and unobservable) which are common to a given specialty in a given province in a given year. As previously noted, we include a θ_{j}^{s} component in the error term to capture unobserved non-pecuniary specialty-specific benefits which are constant over time such as status. Given that we include only individuals of the same province and that the

unobserved component θ_j^s is constant over time, it becomes part of the estimated constant term. Finally, in (10) ϵ_{it}^s denotes an iid error term which may include unobserved physician characteristics such as ability.[9]

The estimation strategy is as follows. We first estimate (10) separately for each province with a medical school using a Multinomial Logit. In the Multinomial Logit specification we assume that the unobserved utility associated with each specialty is a function of individual characteristics (X_{it}) including the individual's age at the time of graduation (and the square of the age at graduation), the sex, the medical school attended, and the language spoken. The age at graduation and its square are included to reflect the fact that sunk costs associated with specialization are likely to be more important for older physicians since they have fewer years of practice to recover such costs as well as potentially higher opportunity costs due to such things as familial obligations. The sex of the individual is included to capture both potential differences in opportunities to specialize, different sunk costs (for example due to childbearing and rearing) and preferences. We also include language to reflect potential differences in opportunities and preferences.[10] Furthermore, we include the medical school attended as it may capture, among other things, the potential differences across training opportunities (for example, differences in availability in residency programmes). As noted above, the dummy variables $\Upsilon(t)$ are included (setting $\widetilde{A}_{jt=1975}^s = 0$ for identification purposes) to capture the manner in which elements which may differ across provinces and across time can influence the physician's decision to specialize and choice of specialty. These variables could include both pecuniary as well as non-pecuniary benefits which change over time; some of which are observable to the econometrician and some of which are not.

Given that we re-estimate the model separately for each province, all elements which are specialty and time specific, are captured in the $\Upsilon(t)$ terms; these elements could include non-pecuniary elements such as the working environment, resources available, as well as rationing in physician spe-

[9] As long as unobserved ability is uncorrelated with our explanatory variables, no bias is introduced by its omission.

[10] A language dummy is included only for Quebec, Ontario and Manitoba residents.

cialty programmes (we return to the issue of rationing in greater detail below). By doing so, we obtain consistent estimates for each $\widetilde{A}^s_{jt}$ (one per year per specialty for each province).

In the second stage of the model, we decompose the 'year effects'. That is, we wish to identify how variations across provinces and across time in variables such as the proxies for fees paid to GPs and Specialists can help explain physicians' decisions to specialize as well as choices among specialties. From the Multinomial Logit estimates of $\widetilde{A}^1_{jt}$ and $\widetilde{A}^2_{jt}$ (denoted $\widehat{A}^1_{jt}$ and $\widehat{A}^2_{jt}$) in (10), we next estimate:

$$\widehat{A}^1_{jt} = W^1_{jt}\gamma^1 + \mu^1_{jt} \tag{11}$$

and:

$$\widehat{A}^2_{jt} = W^2_{jt}\gamma^2 + \mu^2_{jt}. \tag{12}$$

In (11) and (12), $\widehat{A}^1_{jt}$ and $\widehat{A}^2_{jt}$ are both vectors of length $J * T$ (where J denotes the total number of provinces with a medical school and T denotes the total number of years in our sample) and where superscripts 1 and 2 denote the choice of a non-surgical and surgical specialty respectively. Furthermore, the vector W^s_{jt} includes a list of observable province-time specific variables and national-time specific variables which may affect a physician's decision to specialize and his or her choice of specialty including: (i) the ratio of the average cost-per-consultation for GPs and the average cost-per-consultation for Specialists[11]; (ii) provincial wide macro level health care variables including total hospital expenditures, total capital expenditures, total drug expenditures, and total physician expenditures; and (iii) Canadian-wide macro level variables including the proportion of GPs and Specialists per 1000 population in Canada. All of these variables are included to capture

[11]It is likely that the average-cost-per-consultation (ACPC) does not fully reflect the potential net-income in each specialty. That is, although the ACPC may reflect the payment received for a consultation by a specialist, it does not take into account expenses incurred by the physician per consultation. Given that these expenses are likely to be different for generalists and specialists, it would seem reasonable to construct a net-cost-per-consultation variable. However, this is not necessary in our setup as our estimation strategy exploits the variation in these variables over-time (i.e., relative to a base year). Thus, as long as expenses vary as a proportion of the cost-per-consultation, the average-cost-per-consultation remains a valid proxy for potential income.

the differences in the health care market conditions across time at the provincial level as well as at the national level.

In the above discussion, we did not explicitly consider rationing in specialty residency programmes. As pointed out by Nicholson (2002), residency positions are often rationed and as a consequence, physicians may not be able to enter the specialty which would yield them the highest utility. Although rationing may be an important issue, it is unlikely to play a large role here given that we aggregate all non-surgical specialties and aggregate all surgical specialties. Consequently, the probability that a physician who is not admitted into a particular surgical (non-surgical) specialty is unable to specialize in any surgical (non-surgical) specialty should be relatively small. Nonetheless, our estimation strategy does partially control for any remaining rationing in residency programmes. If rationing is province-specialty specific (i.e., it is constant across time within a province), then estimates of the A^s_{jt} will not be contaminated by rationing since they are estimated relative to the base year of 1975 (i.e., $\widehat{A}^s_{jt} = \overline{A}^s_{jt} - \overline{A}_{j,1975}$). However, if rationing varies greatly across time within a province, then the $\widehat{A}^s_{jt}$ parameters likely capture some of the effect of rationing. Given that the available spaces in residency programmes are negotiated with the federal government and do not vary much over time, it is likely that most of the rationing is in fact province-specialty specific.

Another important issue is the possibility that earnings by specialty are correlated with unobserved non-pecuniary specialty-attributes (such as status). That is, physicians may be more likely to specialize in higher paying specialties, not exclusively because they offer higher expected incomes but, because they also offer other non-pecuniary benefits such as status or a challenging work environment. If this is the case, then income effects may be biased. This, however, is unlikely to be an issue in our setup as we identify the income effect through variations in the ratio of exogenous fees across provinces and across time. These variations are unlikely to be correlated with non-pecuniary benefits, given that non-pecuniary benefits are relatively stable across time and across provinces and controlled for in the θ^s_j term.

In the above specification, we assume that μ_{jt}^1 and μ_{jt}^2 follow a $N(0, \quad)$ where $\quad = \begin{bmatrix} \sigma_1^2 & \sigma_{1,2} \\ \sigma_{2,1} & \sigma_2^2 \end{bmatrix}$. Given that we use the same set of explanatory variables in both regressions, we run OLS on both equations controlling for autocorrelation using the Cochran-Orcutt procedure assuming an AR(1) process.

5 Results

In the following section we report results from the above model, including the effect of individual characteristics, institutional factors and potential income, on physicians' decisions to specialize and choices among specialties. In section 5.1 we simulate the effect of an increase in cost-per-consultations for specialists on these decisions.

5.1 Estimation Results

The results from the first-stage Multinomial Logit model are presented in Tables 5 and 6. Table 5 presents the estimation results for the probability of entering into a non-surgical specialty, whereas Table 6 presents the estimation results for the probability of entering into a surgical specialty. In the following discussion, all results should be interpreted relative to the baseline group which is *not* specializing.

Estimates suggest that in most provinces, women are less likely to choose a non-surgical specialty relative to practising as a GP - such is the case for female physicians in Nova Scotia, Quebec, Ontario, Alberta and British Columbia. However, women in Manitoba appear to be more likely to specialize in a non-surgical specialty than to enter general practice. Results also indicate that women in all provinces are less likely to enter into a surgical specialty than to be a GP. Given that opportunity costs of specialization are likely to be greater for women, due to childbearing and child-rearing, this result is not surprising. This result may also reflect differences in preferences for specialization across sexes or barriers to entry into specialization for women.

Estimates also suggest that older physicians are less likely to choose a non-surgical specialty in

Nova Scotia, Quebec, Ontario, Saskatchewan and Alberta (yet positively correlated in Manitoba) and, less likely to choose a surgical specialty (although not significantly in all provinces). That in most provinces age plays a role is not surprising given that older physicians have, ceteris paribus, a shorter professional life to recover expenses and lost income associated with specialization. Furthermore, older individuals may be more likely to have outside obligations such as family which may make foregoing income for several years more difficult. Again, consistent with our priors, the effect of age at graduation on non-surgical and surgical specialization increases as the physician's age at graduation increases in many provinces.

It is also important to note here that in both Quebec and Ontario, Francophones are significantly less likely to specialize (relative to not specializing at all) than are their English counterparts. Several reasons may account for this disparity. First, given that some Francophones may be unable to train in a language other than French, the number of residency programmes available to them is much smaller. Furthermore, Francophones may be less mobile after graduation (because of the language barrier or because of attachment to a Francophone environment). Given their smaller market in which to practice as a specialist, the benefits of specializing may be reduced, either because they are subject to local market conditions or because their ability to emigrate to other markets in the future is reduced.

Although individual characteristics are likely to play an important role in the physician's decision to specialize, it is also likely that the medical school attended is an important element in the decision making process. Several effects may be at work here. First, certain medical schools may provide more opportunities for future specialization to their students - for example, by being more research oriented. It may also be the case that certain medical schools (given their location, affiliation to certain hospitals, or because of their faculty) recruit individuals who are more likely to specialize after medical school. Multinomial Logit estimates for the different provinces indicate that, in fact, attending a particular medical school is associated with the choice of specializing both in a non-surgical and a surgical specialty. For example, in Quebec, a province with four medical

schools, graduates from Quebec City's Laval University are less likely to choose a non-surgical specialty compared to University of Montreal graduates. However, McGill University and University of Sherbrooke graduates are more likely to specialize in a non-surgical specialty relative to their University of Montreal counterparts. In Ontario, where there are five medical schools, and in Alberta where there are two, physicians are more likely to specialize in both surgical and non-surgical specialties if they attend a particular medical school (relative to not specializing at all).[12]

With respect to the 'year effect' variables, which are subsequently used to measure the impact of variations in province-specific variables (such as potential income) on the decision to specialize in both non-surgical and surgical specialties, they appear to account for much of the variation in non-surgical and surgical specialty decisions. That is, it appears that at least some of the variation in the decision to specialize (either in a non-surgical field or in a surgical field) is explained by factors which are time-varying. It is also important to note that this variation appears to be different across provinces. Thus, it is likely that province-specific variables which vary over time are playing an important role in physicians' decisions to specialize and choices of specialty. This is not surprising given that health care in Canada is a provincial responsibility, i.e., where such things as fees paid to physicians are negotiated at the provincial level. Disaggregating these time effects is the focus of the second stage of our estimation strategy.

In the second stage, we attempt to explain the aforementioned variation across time and across provinces in physicians' decisions to specialize by disaggregating the 'year effects' from the first-stage for both non-surgical and surgical specialties. In this second stage, we estimate the effect of variations across time in (i) average-cost per consultation for specialists and GPs, (ii) provincial hospital, drug, physician and capital expenditures, and (iii) the proportion of specialists and GPs per 1000 population at the national level, on the decision to become a non-surgical specialist and the decision to become a surgical specialist. With respect to the average-cost per consultation, we include the ratio of the average-cost-per-consultation of Specialists to the average-cost-per-

[12] Results for surgical specialties are similar.

consultation of GPs. By doing so, we are able to capture the relative change in the cost-per-consultation of Specialists to GPs. Thus, if Specialists cost-per-consultation increased faster than costs-per-consultation of GPs, we should expect the ratio to be negatively correlated with the likelihood that a physician specializes.

Estimation results (presented in Table 7) suggest that much of the variation in the 'year effects' can be explained by the variation in several province- and national-level variables. More specifically, the second-stage estimates suggest that physicians are more likely to enter a non-surgical specialty (relative to not specializing) as provincial hospital expenditures increase. Hospital expenditures may be positively correlated with non-surgical specialties for several reasons. First, increases in hospital expenditures may be correlated with the demand for in-hospital care which should be correlated with the demand for those who provide such care. As a result, such increased demand may lead to upward pressure on fees paid to specialists and thus increase a physician's likelihood to specialize. It may also reflect other non-pecuniary benefits which may make specializing particularly attractive (i.e., better working environments). However, estimates suggest that physicians are less likely to enter a non-surgical field as total expenditures on physicians increase. Because information on the share of physician expenditures directed towards GPs and the share directed towards Specialists is unknown, interpreting this finding is difficult. One surprising result it that there does not appear to be an income effect when graduates decide to specialize in a non-surgical specialty.

With respect to surgical specialists, the results are considerably more dramatic. First, as with the non-surgical case, physicians are more likely to specialize in a surgical specialty as hospital expenditures increase. Again, given that surgeons practice mainly in hospital settings, an increase in hospital expenditures should lead to physicians choosing such a specialty both for pecuniary and non-pecuniary benefits. Furthermore, there appears to be a density effect when physicians decide on whether or not to enter a surgical specialty. More specifically, the probability of entering into a surgical specialty is increasing in the per capita number of surgical specialists. This could either reflect the fact that (i) physicians enter surgical specialties when there exists a critical mass which

may be able to negotiate favourable working conditions (both pecuniary and non-pecuniary), or (ii) this type of medicine is of increasing importance.

One of the most striking results is that physicians are significantly more likely to enter into surgical specialties as the ratio of generalist to specialist average-cost-per-consultation decreases. That is, as the average-cost-per-consultation for specialists increases relative to the average cost-per-consultation for generalists, physicians are more likely to specialize in a surgical specialty (relative to remaining a generalist). This suggests that, when it comes to choosing a surgical specialty, relative to not specializing at all, physicians do in fact respond to increases in potential income. Again, it is important to emphasize the fact that the income effect measured here does not suffer from a selection bias which we would expect if we were to use 'average-income within specialty' as a measure of potential income. Furthermore, it is unlikely to capture unmeasured non-pecuniary specialty attributes, such as status, as these are unlikely to vary with the ratio of exogenous fees.

5.2 Estimated Income Elasticity

In this section, we calculate an estimated income elasticity for both non-surgical and surgical specialties by simulating an increase in average-cost-per-consultation for specialists (relative to generalists) and examining its effect on the decision to specialize and the choice among specialties. More specifically, by using the results presented above, we simulate a 10 per cent increase in specialty average-cost-per-consultation and calculate the predicted change in specialty decisions for the 1991 graduating cohort. That is, we first predict the probability of specializing and the choice of specialty using the actual average-cost-per-consultation data for 1991, then we repeat the exercise, increasing the average cost-per-consultation for specialists by 10 per cent in 1991. Results, presented in Table 8, suggest that increasing the average-cost-per-consultation for specialists will lead to a decrease in the proportion of physicians who choose not to specialize (i.e., practice as a GP) and an increase in the proportion of physicians who choose to specialize in a surgical field (with only marginal decreases in the amount of physicians who choose a non-surgical field). For

example, in Quebec, a 10 per cent increase in average-cost-per-consultations for specialists leads to a predicted decrease of 2.33 per cent in GPs, a 0.72 per cent decrease in non-surgical specialists and a 3.05 per cent increase in surgical specialists. On the other hand, the predicted increase of surgical specialists of 0.55 per cent in British-Columbia is considerably smaller.

6 Discussions

In this paper, we estimate the determinants of physicians' specialty decisions. By using data on virtually all Canadian physicians in Canada from 1989 to 1998, and by exploiting the fee-for-service setting in Canada, we estimate the effects of various factors including expected income on physicians' decisions to specialize, and their choice of specialty. Because we use a truly exogenous measure of income (average-cost-per-consultation) for generalists and specialists, we avoid the potential sample-selection bias associated with prior results found in the literature. Furthermore, because we measure the income effect through variations in potential-income and not differences in levels, our income-elasticity estimates are not contaminated by potential non-pecuniary benefits which could be correlated with potential pecuniary benefits. Finally, we address the potential problem associated with rationing in residency programmes which may have lead to downward-biased income-elasticity estimates in the past. Our results suggest that physicians do in fact respond to differences in income when making their specialty decisions. More specifically, our simulation exercise suggests that provinces could increase the proportion of graduates who select a surgical specialty by increasing the fees they pay to them.

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Table 1: Summary statistics on the year of graduates per 'language' and per gender

	Language				Gender				
Year of	English		French		Female		Male		Total
Graduation	Number	Share	Number	Share	Number	Share	Number	Share	
1975	1144	75.3	374	24.7	347	22.9	1171	77.1	1518
1976	1263	74.4	435	25.6	424	25	1274	75	1698
1977	1254	75.1	415	24.9	459	27.5	1210	72.5	1669
1978	1312	75.1	436	24.9	527	30.1	1221	69.9	1748
1979	1336	75.3	438	24.7	558	31.5	1216	68.5	1774
1980	1343	76.3	418	23.7	580	32.9	1181	67.1	1761
1981	1369	75.6	442	24.4	611	33.7	1200	66.3	1811
1982	1367	75.6	441	24.4	656	36.3	1152	63.7	1808
1983	1395	76.4	431	23.6	688	37.7	1138	62.3	1826
1984	1422	77.2	421	22.8	690	37.4	1153	62.6	1843
1985	1503	77.4	438	22.6	802	41.3	1139	58.7	1941
1986	1451	76.9	437	23.1	818	43.3	1070	56.7	1888
1987	1407	77.7	403	22.3	784	43.3	1026	56.7	1810
1988	1402	75.9	444	24.1	755	40.9	1091	59.1	1848
1989	1374	77.2	405	22.8	798	44.5	981	55.5	1779
1990	1327	76.2	414	23.8	775	44.5	966	55.5	1741
1991	1352	78.5	371	21.5	775	45	948	55	1723
Total	23021	76.3	7163	23.7	11047	36.6	19137	63.4	30184

Table 2: Summary statistics on the Decision to Specialize and on the Type of Specialty by year of Graduation

	Dec. Spec.				Spec. Choice.			
Year of	Gen.		Spec.		Surg.		Non-Surg.	
Grad.	Number	Share	Number	Share	Number	Share	Number	Share
1975	815	53.7	703	46.3	194	27.6	509	73.4
1976	924	54.4	774	45.6	190	24.5	584	75.5
1977	887	53.1	782	46.9	204	26.1	578	73.9
1978	904	51.7	844	48.3	208	24.6	636	75.4
1979	914	51.5	860	48.5	229	26.6	631	76.4
1980	832	47.2	929	52.8	256	27.6	673	47.4.
1981	891	49.2	920	50.8	218	23.7	702	76.3
1982	881	48.7	927	51.3	260	28	667	72
1983	859	47	967	53	256	26.5	711	73.5
1984	913	49.5	930	50.5	237	25.5	693	74.5
1985	1017	52.4	924	47.6	227	24.6	697	75.4
1986	960	50.1	928	49.9	255	27.5	673	72.5
1987	999	55.2	811	44.8	226	27.9	585	72.1
1988	1005	54.4	841	44.6	235	27.9	606	72.1
1989	995	56	784	44	224	28.6	560	71.4
1990	1009	58	732	42	188	25.7	544	74.3
1991	965	56	758	44	235	31	523	69
Total	14977	49.6	14414	50.4	3742	26	10572	74

Table 3:

Average-Cost-Per-Consultations for GPs per Province for the period 1976-1991

Province	Min	Max	Mean	Std. Dev.
British Columbia	19.85965	26.86008	23.63442	2.491298
Alberta	18.27851	27.59816	22.71749	2.945301
Saskatchewan	13.70614	18.96403	16.5001	2.15093
Manitoba	15.04624	19.00308	16.84445	1.287865
Ontario	14.97302	26.18131	20.65059	4.269397
Quebec	16.16886	21.04008	18.53719	1.368644
Nova Scotia	14.42389	20.12364	17.47883	2.298705
Newfoundland	12.92171	16.87351	15.25827	1.585122

Table 4:

Average-Cost-Per-Consultations for Specialists per Province for the period 1976-1991

Province	Min	Max	Mean	Std. Dev.
British Columbia	36.93046	53.52246	43.7504	5.305364
Alberta	20.8333	38.66598	31.68855	5.676567
Saskatchewan	25.62061	34.31855	30.08789	3.414675
Manitoba	20.73796	29.17887	24.86598	3.16826
Ontario	24.65132	40.63964	31.93857	6.361952
Quebec	22.12	26.72251	24.27642	1.558948
Nova Scotia	22.72832	41.43885	31.29941	7.08552
Newfoundland	22.81798	35.10804	29.14358	4.046635

Table 5: Choice=non-surgical specialty[13]

	Nfld.[14,15]	N.S.	Queb.[16]	Ont.[17]	Man.	Sask.	Alb.[18]	B.C.
Laval			-.125**					
Sherb.			.161**					
McGill			.676***					
Ott.				.045				
McMas.				.432***				
Queen				.161**				
UWO				-.047				
Calg.							.249***	
Fem.	-.008	-.498***	-.363***	-.257***	.341***	.1236	-.458***	.-408***
Engl.			.498***	.713***	-1.566			
Age t	-.290	-1.088***	-.435***	-.597***	.413*	-.551***	-.459***	-.497
Age t^2	.003	.017***	.006***	.009***	-.005	.007**	.006***	.008
1976	-.023	.190	-.189	.100	-.381	-.275	.081	-.028
1977	.199	-.213	-.147	.206	-.410	.233	-.051	-.545
1978	-.289	-.055	-.296**	.587***	.074	.171	.084	-.013
1979	.852**	.363	.008	.212*	-.261	-.068	-.308	.159
1980	.071	.217	.317**	.248*	-.744**	-.102	.265	-.070
1981	.386	-.016	.303**	.386***	-.389	-.153	.260	-.205
1982	.612	.168	.229*	.403***	.163	.799*	-.002	.150
1983	.361	-.146	.377***	.488***	-.526	-.223	.244	.193
1984	.609	-.184	.346***	.456***	.300	.836**	.097	-.294
1985	.461	-.169	.197	.211*	-.318	-.181	.176	-.012
1986	.013	.303	.202	.268**	-.022	.881**	.080	.233
1987	.126	.456	.259*	-.123	-.139	-.056	.058	-.393
1988	.616	.353	.351***	.077	.544*	.255	-.231	-.481
1989	-.634	-.024	.299**	.000	.336	.537	.033	-.416
1990	-.112	-.316	.400***	.019	.470	.416	-.219	-.735**
1991	-.331	-.191	.624***	-.111	.577*	.267	-.174	-.929***

[13]* coefficient significant at the 10% level, ** coefficient significant at the 5% level, *** coefficient significant at the 1% level.

[14]In Newfoundland, the Medical School is omitted as the province has only one medical school. Such is also the case for Nova Scotio, Manitoba, Saskatchewan and Bristish Columbia.

[15]In Newfoundland, as in Nova Scotia, Manitoba, Saskatchewan, Alberta and British Columbia, the English Variable is excluded as the French population is insignificant.

[16]For Quebec, the University of Montreal serves as the comparison medical school.

[17]For Ontario, the University of Toronto serves as the comparison medical school.

[18]In Alberta, the University of Calgary serves as the comparison medical school.

Table 6: Choice=surgical specialty

	Nfld.	N.S.	Queb.	Ont.	Man.	Sask.	Alb.	B.C.
Laval			-.262***					
Sherb.			.087					
McGill			.270**					
Ott.				.024				
McMas.				.193*				
Queen				.460***				
UWO				.125				
Calg.							.098	
Fem.	-.603***	-1.625***	-.821***	-.950***	-.344*	-1.22***	-1.143***	-1.101***
Engl.			.941***	.733**	14.593***			
Age t	.241	-1.131***	-.310*	-.236	-.233	-.492*	-.302	-.294
Age t^2	-.005	.017****	.003	.001	.003	.005	.003	.002
1976	.397	.647	-.282	-.163	.052	-.478	-.190	-.542
1977	1.095	.236	-.234	.107	-.161	-.346	-.174	.024
1978	.078	.043	-.342*	.292*	-.107	-.030	-.261	1.125*
1979	1.196	1.296***	.204	-.235	-.620	.292	-.236	1.147*
1980	.965	.727	.236	.357**	-1.221**	.282	.189	.968
1981	1.608**	-.294	.207	.241	-.457	.207	-.656*	.145
1982	-.151	.797*	.309	.372**	-.306	1.298**	.198	1.095*
1983	1.717**	.588	.224	.465***	-.433	.142	.082	1.479***
1984	1.390*	.993**	.169	.232	.090	1.006*	.030	.615
1985	1.006	.275	.224	-.109	.101	.620	-.424	1.051*
1986	1.545**	.919**	.248	.253	.0870	1.591***	.052	.669
1987	1.129	.730	.362*	-.006	.133	.519	-.474	.942
1988	1.277*	.551	.649***	-.012	-.250	.927*	-.306	.319
1989	1.008	.317	.509***	-.045	.457	1.615***	-.079	-.019
1990	.792	-.211	.556***	-.017	-.332	.229	-.470	-.026
1991	.229	.368	.863***	.177	.329	.136	-.039	.752
LR X^2[19]	97.66	160.34	898.34	613.81	129.48	124.46	173.99	135.64
(df)	(38)	(38)	(46)	(48)	(39)	(38)	(40)	(38)

[19]Note that for all provinces, Prob>$X^2 = 0.0000$.

Table 7: OLS Results from for the 'year effects':

	$\widehat{A}^1$ (non-surgical)	$\widehat{A}^2$ (surgical)
hosc95	.00015**	.00020*
	(.00007)	(.00011)
drug95	.00029	.00020
	(.00033)	(.00011)
cap95	.00027	−.00026
	(.00040)	(.00061)
phy95	−.00052**	−.00050
	(.00023)	(.00035)
ratio	−.54423	−3.31874***
	(.59235)	(.91286)
praspp	3.04143	8.69266**
	(1.61110)	(2.46456)
prgpp	−2.15116	−5.48922***
	(1.96595)	(3.00573)

Table 8: Predictions for 1991 increased Specialty Fees by 10% on specialty choice.

Province	GP		Non-Surgical		Surgical	
Ontario	GP_{pre}	54.44%	NS_{pre}	35.27%	S_{pre}	10.29%
	GP_{post}	52.26%	NS_{post}	35.18%	S_{post}	12.56%
	GP_{change}	-2.18%	NS_{change}	-0.09%	S_{change}	2.27%
Quebec	GP_{pre}	43.69%	NS_{pre}	44.59%	S_{pre}	11.72%
	GP_{post}	41.36%	NS_{post}	43.87%	S_{post}	14.77%
	GP_{change}	-2.33%	NS_{change}	-0.72%	S_{change}	3.05%
British Columbia	GP_{pre}	60.65%	NS_{pre}	37.90%	S_{pre}	1.45%
	GP_{post}	60.42	NS_{post}	37.58%	S_{post}	2%
	GP_{change}	-.23%	NS_{change}	-0.32%	S_{change}	.55%
Alberta	GP_{pre}	57.64%	NS_{pre}	31.23%	S_{pre}	11.13%
	GP_{post}	55.98%	NS_{post}	31.14%	S_{post}	12.88%
	GP_{change}	-1.66%	NS_{change}	-0.09%	S_{change}	1.75%
Newfoundland	GP_{pre}	49.59	NS_{pre}	40.55%	S_{pre}	9.86%
	GP_{post}	47.98	NS_{post}	40.48%	S_{post}	11.54%
	GP_{change}	-1.61%	NS_{change}	-0.07%	S_{change}	1.68%
Saskatchewan	GP_{pre}	55.82%	NS_{pre}	31.05%	S_{pre}	13.13%
	GP_{post}	53.76%	NS_{post}	30.81%	S_{post}	15.43%
	GP_{change}	-3.06%	NS_{change}	-0.24%	S_{change}	2.3%
Manitoba	GP_{pre}	41.7%	NS_{pre}	47.80%	S_{pre}	10.5%
	GP_{post}	39.62%	NS_{post}	47.47%	S_{post}	12.91%
	GP_{change}	-2.08%	NS_{change}	-0.33%	S_{change}	2.41%
Nova Scotia	GP_{pre}	57.63%	NS_{pre}	31.24%	S_{pre}	11.13%
	GP_{post}	55.98%	NS_{post}	31.14%	S_{post}	12.88%
	GP_{change}	-1.65%	NS_{change}	-0.10%	S_{change}	1.75%

7 Data Appendix

Source	Variable	Description
Southam Data Base	Age t	Denotes the physician's age at graduation Constructed from data on (1) the physician's date of birth and, (2) the Physician's age at graduation
	Age t^2	Denotes the square of physician's age at graduation
	Sex	Denotes the physician's sex
	1976,...,1991	Dummy variables constructed for the year of graduation from medical school (graduated in 1975 is the comparison group)
	Laval	Dummy variable =1 if the physician graduated from Laval University
	Sherb.	Dummy variable =1 if the physician graduated from the University of Sherbrooke
	McGill	Dummy variable =1 if the physician graduated from McGill University (graduated from the University of Montreal is the comparison group fophysicians who graduated from a Quebec University)
	Ott.	Dummy variable =1 if the physician graduated from the University of Ottawa
	McMas.	Dummy variable =1 if the physician graduated from McMaster University
	Queen	Dummy variable =1 if the physician graduated from Queen's University
	UWO	Dummy variable =1 if the physician graduated from the Univesity of Western Ontario (graduated from the University of Toronto is the comparison group for physicians who graduated from an Ontario University)
	Calg.	Dummy variable =1 if the physician graduated from the University of Calgary (graduated from the University of Alberta is the comparison group for physicians who graduated from an Alberta University)

Source	Variable	Description
OECD Health Data (2000)	hosc95	Per capita hospital expenditures in 1995 dollars
	drug95	Per capita drug expenditures in 1995 dollars
	cap95	Per capita capital expenditures in 1995 dollars
	phy95	Per capita physician expenditures in 1995 dollars
	praspp	Proportion of Specialists per 1000 population
	prgpp	Proportion of GPs per 100 population
National Physician Database	ratio	Ratio of the average-cost-per-consulation for GP services to the average-cost-per-consulation for Specialist services